VERIFICATION OF TRANSLATION

Japanese Patent Application No 11-234517

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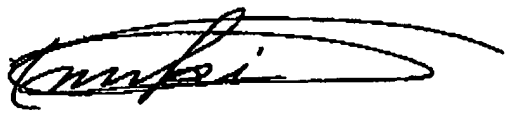

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[Title of Invention] IMAGE PROCESSING DEVICE

[Claims]

[Claim 1] An image processing device comprising:

an image processing means wherein, when a first object and a second object move in a game space, the movement of said first object is controlled by inputting operations at an operation member, and if there is an input of operations at the operation member to match the movement timings of both objects, image processing is performed in order to make the motion of said first object influence the movement of said second object; and

a controlling means for controlling the speed of the motion of said first object in accordance with the operation timing of said first object corresponding to said second object.

[Claim 2] The image processing device according to Claim 1, wherein said controlling means is structured such that when said timing is shifted from an appropriate timing, said controlling means amends the moving motion according to the extent of this shift.

[Claim 3] The image processing device according to Claim 2, wherein said controlling means is structured to perform a low speed motion if said timing is faster than the appropriate timing, and to perform a high speed motion if said timing is slower than the appropriate timing, so that the moving timings of the first object and the second object match as a result.

[Claim 3] The image processing device according to Claim 1, used for a game device for ball games such as baseball games, tennis games, soccer games, and basketball games etc., wherein said second object is an object which flies and said first object is a tool used to collide with said second object.

[Claim 4] An image processing device comprising an image processing means for performing the image processing movement which controls to operate the motion character which conducts a series of movements in order to change the moving direction of a movable body on the screen, in the timing of operating the operation member,

wherein, said image processing means comprises a movement controlling means wherein the time range appropriate for the operation input at said operation member is set in advance, and when there is the operation input at said operation member within this time range, said motion character is moved at the correct movement speed in advance, and when there is an operation input at said operation member outside said time range, a movement speed of said motion character is controlled.

[Claim 5] An image processing device comprising an image processing means for performing the image processing movement which controls to operate the motion character which conducts a series of movements in order to change the moving direction of a movable body on the screen, in the timing of operating the operation member,

wherein, said image processing means comprises a movement controlling means wherein the time range appropriate for the operation input at said operation member is set in advance, and when there is the operation input at said operation member within this time range, said motion character is moved at the correct movement speed in advance, and when there is an operation input at said operation member before said time range, said motion character is moved at a lower speed than said accurate movement speed, and when there is an operation input at said operation member behind said time range, the motion character is moved at a faster speed than said accurate movement speed.

[Claim 6] The image processing device according to Claim 4 or 5, wherein there are impact timings of the movable body and the motion character in said series of movements, and said movement controlling means match said impact timings when the operation input at said operation member is outside said time range.

[Claim 7] An image processing device comprising a tennis game program for performing the image processing movement which can make a player on the screen swing a tennis racket and hit a tennis ball back to a competitor's side according to the user's operation of the keys, further comprising:

a swinging movement performing means for performing a swinging movement to hit the tennis ball according to the key operation, after moving said player to the position of the tennis ball;

a judging means which is stored with the time range appropriate for the input of said key operation and judges whether said key operation is input within this time range;

a movement controlling means for performing said swinging movement at the accurate movement speed, when, as a result of the judgment at said judging means, it is judged that said key operation was input within said time range; and

an amending means for, as a result of the judgment at said judging means, performing said swinging movement at a lower speed than said accurate movement speed when it is judged that said key operation is input before said time range, performing said swinging movement at a faster speed than said accurate movement speed when it is judged that said key operation is input after said time range, and amending that at least the impact time matches the accurate movement speed.

[Claim 8] An image processing device comprising a character model and a polygon model for applying a transparency set to this character model,

wherein said polygon model is applied to said character model and when applying said character model to this polygon model, the image processing of half transparency is performed for said character model based on said transparency data.

[Claim 9] The image processing device according to Claim 8, wherein data for gradation processing, by which the transparency changes in order, is set for said polygon model, and when said character model is applied to said polygon model, the gradation processing of half transparency is performed for said character model.

[Claim 10] The device according to Claim 8 or 9, wherein said character model is a projection image model corresponding to the object.

[Claim 11] The device according to Claim 10, wherein said projection model is a shadow model of the object.

[Claim 12] The device according to Claim 8 or 9, wherein there is a plurality of projection image models and said processing of transparency of said polygon model is performed to the plurality of projection image models.

[Claim 13] The device according, to Claim 10, wherein there is a plurality of pairs of said projection image models of characters and said polygon models, and when these pairs overlap, a disabling means is provided between the bottom pair and top pair for disabling the data of transparency of the polygon model of the bottom pair.

[Claim 13] The device according to Claim 8 or 9, wherein said disabling means includes separately an additional polygon model of which transparency is set 0, and this additional polygon model is set upon the projection image model of said character.

[Claim 14] The device according to Claim 8 or 9, wherein said polygon

model is a tabular polygon and said character model is arranged on this tabular polygon.

[Claim 15] An image processing device comprising an image processing means for performing an image processing movement which generates a shadow of the motion character moving on the display screen, when lights are irradiated to the motion character by a plurality of light sources, further comprising:

a shadow model which has color information and the transparency of 100% designated corresponding to each of the light sources;

a gradation table wherein each of said shadow models overlap, each making a top layer and the transparency of said shadow models is set; and

a filter polygon which is overlapped under the graduation table except the match of the shadow model and the graduation table which is at the bottom most layer, has no color information designated but the transparency of 0% designated.

[Claim 16] A game device comprising the image processing device according to one of the Claims 1 to 15.

[Claim 17] A storage medium for a TV game, wherein a program for performing image processing means according to one of the Claims 1 to 15 is stored.

[Detailed Description of the Invention]

[Field of the Invention]

The present invention relates to an image processing device and a game device, particularly to an image processing device to perform a program for a game device for business or family use.

[Related Art and Problems to be Solved by the Invention]

In recent years, many simulated games are provided as game programs for game devices, particularly for video game apparatuses. The object of these

simulated games is to compete with others or a computer device which is the main body of processing of the game device over the dominance of the game, while experiencing actions such as the fighting between characters appearing in the game, car racing competitions, and sport contests etc.. Particularly in a simulated game of a sport contest using a ball, the user operates a plurality of keys in a controller for providing the main game body with operation signals and controls the behaviors of a character such as a human character who appears in the game. Here, in a tennis game for performing tennis matches, one of competitors is selected, and the movements or behaviors of the selected player, for example, serving a tennis ball and hitting the ball which a competitor hits, are controlled by operating the keys in the controller device which is equipped in the game body so that tennis is performed. For example, the movements of the player are controlled so that the player serves a tennis ball or hits the ball which a competitor hits. Therefore, the movements of the tennis ball depend on the key operation at the controller which performs the movements and behaviors of swinging a racket of the player selected by the user.

When the timing for swinging the tennis racket is shifted, in particular, there is a problem that the player can not hit the tennis ball accurately with the tennis racket so the player misses the ball and the direction of the ball is shifted from the intended direction.

Here, the structure of the data of the tennis game is, what is called, a 3D data structure. In the screen seen from a virtual camera, one player is located closer to the virtual camera and the other player is located farther away from the virtual camera, therefore, the user can recognize the perspective of the images on the screen.

Moreover, as it is required to change sides during a tennis match, the player operated by the user alternates the side between the side closer to the virtual

camera and the side farther away from the virtual camera in order to, for example, keep the sense of faimess for the match between two. Because of this, it is difficult for the player to understand the timing for swinging the tennis racket, therefore, it can be predicted that the timing for hitting the ball with the racket, in other words, the impact is shifted. Formally, it is not easy to hit the ball which is a small flying body by moving the player character accurately, in a screen where a model in a 3D space is converted into a picture of 2 dimensions.

In a tennis game, for example, the conventional technologies amend the timing of the player swinging the racket with respect to the thrown ball. However, it can be against the user's desire to accelerate or delay the timing of starting to swing the racket.

Next, other problems of the conventional technology are explained. In the conventional inventions, the image processing displays a model which is half transparent, such as a texture, by providing the image data with the data of transparency. In this image processing as a conventional example, the background can be seen through characters by providing the models such as characters with the data of half transparency. This data of half transparency is called α, and the processing of half transparency becomes possible by setting the value of the α in the range from 0 to 1 properly.

This half transparency processing has been broadly used in the field of CG in the case of performing representations of the screen, and as an example of applying such processing, there is a case of displaying a shadow to a character. Regarding this processing, there was a case when the value of α is given to the polygon model of a shadow and the shadow is displayed as half transparent on the land of the background. α is set for the data of each vertex data of a polygon constituting the shadow, and the value a of the picture element parts except the

vertexes is calculated by interpolation.

In this conventional example, a part where the shadow models overlap, the value α of the shadows is duplicated and so that the part is displayed darkly, in short, that part is displayed at lower transparency than other parts. For example, in the case of a human body, the shadow part of joints, where the shadow polygon corresponding to a brachial arm and the shadow polygon corresponding to a lower arm overlap, is displayed as a dark shadow. In the real world, it is unnatural if the joint part has a darker shadow than the other parts, therefore, the user feels incompatibility when such a problem is ignored in the image processing device.

Furthermore, in a 3D game, shadows are generated by the lights from floodlights corresponding to the character such as the player. By the way, there is a case when such shadows overlap one another when, for example, a plurality of floodlights exist in different positions. Here, there has to be a difference between the darkness of the shadow generated by the quantity of light of 1 floodlight and the darkness of the shadow generated by the quantity of light of 2 floodlights, however, there is no improvements made regarding such a point in the conventional game devices. If the shadow is not realistic, there will be a difference for the user between a real shadow and the shadow in the game, and the interest of the user to the game will be lost.

The object of the present invention is to provide a system in which a game using a game device can be developed smoothly by assisting the user's operation of the game device. The next object of the present invention is to provide a game device for hitting or hitting back an object such as a ball by a series of movements in a short period such as swinging a racket or a bat, wherein the series of movements are preferably matched to the behaviors of an object such as a ball by accurately assisting or helping the user's operation without impairing the user's will.

The other object of the present invention is to display a highly realistic representation of the game image. The next object of the present invention is to provide a game device which allows processing such that the display of shadows of objects on the game screen complies with the display of real shadows.

[Means for Solving the Problems]

In order to achieve the objects, the present invention comprises an image processing means wherein, when a first object and a second object move in a game space, the movement of the first object is controlled by inputting operations at an operation member, and if there is an input of operations at the operation member to match the movement timings of both objects, image processing is performed in order to make the moving motion of the first object influence the movement of the second object, and controlling means for controlling the speed of the moving motion of the first object in accordance with the operation timing of the first object corresponding to the second object.

The other manner of the present invention is explained as follows. The controlling means is structured such that when the timing is shifted from an appropriate timing, the controlling means amends the moving motion according to the extent of this shift. The controlling means is structured to perform a low speed motion if the timing is earlier than the appropriate timing, and perform a high speed motion if the timing is later than the appropriate timing, so that the moving timings of the first object and the second object match as a result. The second object is an object which flies and the first object is a tool to collide with the second object, and the described image processing device is used for a game device for ball games such as baseball games, tennis games, soccer games, and basketball games etc..

According to the present invention, these objects can be achieved not by controlling the timing of beginning a movement of an object itself, but by giving

precedence to controlling the motion of the object.

The image processing device to achieve the other object of the present invention is characterized in that comprises a character model and a polygon model for applying a transparency set to this character model, wherein the polygon model is applied to the character model and when applying the character model to this polygon model, the image processing of half transparency is performed for the character model based on the transparency data. Therefore, for example, even if the shadows overlap as in the conventional technology. the half transparency processing is performed by the transparency data which is set in the polygon model, therefore, it is possible to avoid generating an image which has incompatibility such that the part where the shadows overlap is displayed at a lower transparency than the other area.

The concrete embodiment of the present invention is an image processing device comprising an image processing means for performing an image processing movement which generates a shadow of the motion character moving on the display screen, when lights are irradiated to the motion character by a plurality of light sources, and this image processing device further comprises a shadow model which has color information and the transparency of 100% designated corresponding to each of the light sources; a gradation table wherein each of the shadow models overlap, each making a top layer and the transparency of the shadow models is set; and a filter polygon which is overlapped under the graduation table except the match of the shadow model and the graduation table which is at the bottom layer, and has no color information but the transparency of 0% designated.

1 shadow model is not influenced by the transparency designated to more than 2 gradation tables because of the function of the filter polygon, therefore, if more than 2 shadows overlap by the light of more than 2 light sources, it is possible to generate realistic shadows such that the shadows are dark where they overlap

and the other independent area of the shadows are faint.

[Mode for Carrying out the Invention]

(First Embodiment)

Fig.1 is a schematic electrical block diagram of the game device. As shown in Fig.1, the game device comprises game processing board 10. The devices such as operation member 51, display member 53, speaker 13, and external extension connector 14 are electrically connected to game processing board 10. The user can play a tennis game by operating each of the devices in operation member 51 while watching the game screen displayed on display member 53.

Game processing board 10 comprises, a counter, which is not illustrated in a diagram, CPU (Central Processing Unit) 21, geometry processor 22, system memory 23, program data ROM 24, boot memory 25, bus arbiter for bus controller 26, rendering processor 27, graphic memory 28, video DAC 29, audio processor 30, audio memory 31, audio DAC 32, and the parts of these elements are connected to one another by bus line 33.

Among these, CPU 21 is connected via bus line 33 to geometry processor 22 and system memory 23, while its first system being connected to program data ROM 24 and boot ROM 25, its second system being connected via I/O 34 to operation member 51, its third system being connected to external extension connector 41 and audio processor 30, and its fourth system being connected to rendering processor 27, respectively. Moreover, rendering processor 27 is connected to graphic memory 28 and video DAC 29. Audio processor 30 is connected to audio memory 31 and audio DAC.

System memory 23 stores a predetermined program and an image processing program of this device in advance. Also, boot ROM 25 stores a system activation program in advance.

CPU 21, after its power is switched on, activates the system by reading the activation program stored in boot ROM 25, and after that, it performs the processing relating to each calculation and control based on a program included in system memory ROM 22. The processing includes a processing of selecting a desired game mode from a plurality of game modes which are set in advance, processing peculiar to each game mode, behavior calculation (simulation) processing of player A, player B, tennis racket 204, and tennis ball 206 (hereinafter referred to as player A etc.) shown in Fig.3, and calculation processing of special effects.

The behavior calculation is to simulate the movements of player A etc. in a virtual 3 dimensional space (game space). In order to perform it, after the coordinate values of polygons of player A etc. in the virtual 3 dimensional space are determined, a conversion matrix and form data (polygon data) to convert the coordinate values into a 2 dimensional visual field coordinate system are designated to geometry processor 23. Furthermore, a polygon data means a coordinate data group of relative or absolute coordinates of each vertex of polygons (polygon: mainly a triangle or quadrangle) which are constituted of a collection of a plurality of vertexes.

The form data constituted of a plurality of polygons (the 3 dimensional data of characters, geography, and background etc. constituted of each vertex) are stored in program data ROM 24 in advance. This form data is sent to geometry processor 22. Geometry processor 22 performs perspective transformation of the designated form data at the conversion matrix sent from CPU 21 and obtains the form data which is converted from the coordinate system of 3 dimensional virtual space into the visual field coordinate system. This form data is sent to rendering processor 27.

Rendering processor 27 reads the texture data from graphic memory 28, pastes the texture to the form data of the converted visual field coordinate system, and outputs the data to the frame buffer inside video DAC 29. The polygon screen

(the result of the simulation) of player A and the background etc. stored temporarily in the frame buffer and the scroll screen with letter information are synthesized in accordance with the designated priority, and the final frame image data is generated at certain intervals. This frame image data is given D/A conversion, sent to display 12, and displayed as a game screen in real time.

Audio processor 30 generates sound data based on the direction from CPU 21 and outputs the data via DAC 32 to speaker 13. Because of this, the sound data is amplified in power and output from speaker 13 as a sound.

Moreover, by operating operation member 51, the player can provide CPU 21 via I/F with the tennis game information such as the game mode advancement information, the movement information of the player A and B, the movement information of tennis ball 206, the information of swinging the tennis racket, and the positional information of the viewpoint of a camera located in the virtual 3 dimensional space etc., while watching the display screen of display member 53.

The game device according to the present invention which is structured as described above, implements a predetermined function by the CPU's performance of the program which is read from program data ROM 24 (external storage device).

This embodiment performs the program of a tennis game stored in program data ROM 24. A tennis game is a match between two players by operating the players, in respective sides of a court using tennis rackets to hit the tennis ball.

A game device to perform such tennis game is structured, as shown in Fig.2 (A), from operation members 51a and 51b, which players A and B operate respectively, and game sequence processing member 52, which performs the processing so that the game program displays the scenes of the tennis match on display member 53 (please refer to Fig.3) according to the operation conditions of these operation members 51a and 51b. Player characters A and B perform

operations for developing the tennis game at operation members 51a and 51b, in accordance with the display screen of display member53 based on the processing of game sequence processing member 52.

Operation members 51a and 51b are structured, as shown in Fig.2 (B), from a plurality of operational buttons 200 and 8 direction stick 202 constituted of an arm which can be moved in 8 different directions. Operational buttons 200 are provided to perform the start of the swinging of the tennis racket 204 and the different ways of swing (drive, cut, etc.), and 8 direction stick 202 is provided to control players A and B to move in the direction of the ball.

Furthermore, when there is 1 player, it is possible to develop the tennis game in, what is called, a computer competition mode in which the operation of the other player is performed by game sequence processing member 52.

Here, the present embodiment is characterized in that the speed of the series of movements when the player character A (or B) swings the tennis racket and hits the tennis ball is controlled (hereinafter, the explanation follows assuming that the player character is an object of this movement control).

As shown in Fig.3, after the player character A moves in the direction of tennis ball 206 in order to hit tennis ball 206 (this movement is performed by operating 8 direction stick 202 (please refer to Fig.2 (B)) which constitutes a part of operation member 51a), the series of movements from the beginning of the swinging of the racket to its end is started/regenerated from the time when operational buttons 200 (please refer to Fig.2 (B)) for swinging tennis racket 204 are operated and input.

Here, if tennis ball 206 exists in the path of the swing of tennis racket 204 in a good timing within a predetermined time range, it is judged that there was a collision of the racket and the ball, in other words, tennis ball 206 was hit. The collision angle of the impact in the time range, in short, the collision angle of tennis

racket 204 and tennis ball 206 is calculated, by which the speed and the direction of the tennis ball isicalculated, then the display control is performed in which the ball is hit to the competitor's side of the court.

If the operation of operational buttons 200 to start the swinging movement is conducted out of the predetermined time range, such swing is judged as a bad swing and the display control is performed in which tennis ball 206 directly moves behind (front side of Fig.3) player character A. Therefore, player character A needs to operate operational buttons 200 with good timing. Moreover, even if the operation timing of operational buttons 200 is accurate, the display control of a bad swing or a mis-hit is performed unless the relative positional relationship between player character A and tennis ball 206 is not in a predetermined range.

In the 2 dimensional display of tennis court 208 on the screen of the present embodiment, player characters A and B are displayed differently in size so that there is the perspective between player characters A and B. Moreover, because of the characteristic of the rules of tennis, player character A exists in the area of the front side 208A in one case but exists in the back side 208B in another case. Here, the shift of timing for swinging tennis ball 206 is liable to happen because of the perspective between front side 208A and back side 208B.

Therefore, the present embodiment provides a time range for the amendment of the timing before and after the predetermined time range. When operational buttons 200 are operated within the time range for amending the timing which is before the predetermined time range, it controls the collision time (impact time) of tennis ball 206 to be within the predetermined time range by slowing down the speed of the series of movements of tennis racket 204, in short, by selecting a slow motion. On the other hand, when operational buttons 200 are operated within the time range for amending the timing which is after the predetermined time range,

it controls that the collision time (impact time) of tennis ball 206 to be within the predetermined time range by quickening the speed of the series of movements of tennis racket 204, in short, by selecting a fast motion.

Fig.4 shows a block diagram of the control described above. The input signal from operational buttons 200 is input to signal generator for starting judgment 210. Signal generator for starting judgment 210 outputs a signal to judgment member 212 at the same time when the operation of operational buttons 200 is input.

Judgment member 212 is connected to A gate signal generator 214 for generating a gate signal based on the predetermined time range, B gate signal generator 216 for generating a gate signal based on the time range for amending the timing before the predetermined time range, and C gate signal generator 218 for generating a gate signal based on the time range for amending the timing after the predetermined time range, and judgment member 212 judges the movement mode based on the condition (1 or 0) of each signal for starting judgment at the time when they are input from signal generator for starting judgment 210. The signal based on the movement mode judged is output to movement selection control member 220, by which the movement mode is selected and sent to display control member 222. Display control member 222 controls display member 224 and displays the series of movements (the movement of swinging tennis racket 204) based on the selected movement mode.

The function of the present embodiment is hereinafter explained with reference to the flow chart in Fig. 5 as well as the timing chart in Fig.6 (A).

In step 300, flag F is reset (0) and in step 302, it is judged whether tennis ball 206 flies to player character A. If it is judged affirmatively, the computer proceeds to step 304 in which player A is moved to the position of tennis ball 206 by operating 8 direction stick 202.

In step 306, it is judged whether player character A is in the appropriate position. and if it is judged that it is in the appropriate position, in short, the position where tennis ball 206 can be hit, the computer proceeds to step 308 to set (1) flag F and further proceeds to step 310. If it is judged that player character A is in the inappropriate position, in short, the position where tennis ball 206 can not be hit, the computer directly proceeds to step 310 by skipping over step 308.

In step 310, it is judged whether operational buttons 200 are operated. In other words, it is judged whether player character A directed to start swinging tennis racket 204. When it is judged affirmatively, the computer proceeds to step 312 in which judgment member 212 analyzes whether the operation time of these operational buttons 200 is appropriate, as shown in Fig.4.

As shown in Fig.6 (A), judgment member 212 takes in each signals and determines the series of movements depending on when the activation of the signal for starting judgment based on the operation of operational buttons 200 is conducted. This determination is performed based on the judgment table in Fig.6 (B).

When the analysis in step 312 (the determination of the series of movements) is over, the computer proceeds from step 312 to step 314 in which a judgment is made regarding whether the operation time of operational buttons 200 was accurate . If the judgment is affirmative, in other words, if it is judged that the operation time of operational buttons 200 was accurate, the computer proceeds to step 316 to set the predetermined series of movements, then proceeds to step 318.

Furthermore, if the judgment is negative, in other words, it is judged that the operation time of operational buttons 200 was not accurate in step 314, the computer proceeds to step 320 in which it is judged whether the operation time is within an amendable range even if the operation time is not accurate. The amendable range means a range in which operational buttons 200 can be operated in the time range

for amending the timing, and if it is judged affirmatively in step 320, an amendment mode is selected in steps 322, 324, and 326. In short, either performing the series of movements at a slow speed (step 324) or performing it at a fast speed (step 326) is set, and the computer proceeds to step 318.

In step 318, it is judged whether flag F is set (1), and if it is judged that it is set, it is possible to hit tennis ball 206 and the computer proceeds to step 328 in which the hitting direction and speed is calculated, then to step 330 in which the series of movements (the movements of swinging tennis racket 204) are displayed. Here, the series of movements are performed at either speed set in step 316, 324, or 326. In step 332, the display of hitting is performed and the processing ends.

On the other hand, if the judgment in step 318 is negative, in other words, if it is judged that flag F is reset (0), the ball can not be hit regardless of the operation time of operational buttons 200, therefore, the computer proceeds to step 334, in which the series of movements (the movements of swinging tennis racket 204) are displayed, then to step 336 in which the display of a bad swing is performed and the processing ends. Furthermore, if it is judged that the operation time of operational buttons 200 is outside the amendable range, the computer also proceeds to step 334 in which the series of movements and a bad swing (step 336) are displayed and the processing ends.

The above embodiment can solve the unfairness among the users which results from the differences in the quantity of experiences regarding the difference in the timing of the series of movements (the movements of swinging tennis racket 204) between front side 208A and back side 208B having the perspective therebetween on the display screen, by providing the time range for amending the timing before and after the predetermined time range which indicates the appropriate operation input of operational buttons 200 for the series of movements, and by slowing down

the speed of the series of movements if the operation of operational buttons 200 is performed early or by quickening the speed if the operation of operational buttons 200 is performed late.

In a mode where the speed of the movements of the player character is fast, such motion is selected from memory and displayed that requires a short time for the player character to begin and end swinging the racket, on the other hand, in a mode where the speed is slow, such motion is selected and displayed that requires a slightly long time in doing it. In these motions, such images are provided that the player character takes postures which correspond to the fast movements and slightly slow movements. Furthermore, the motion of the player character can be obtained from the real-time calculation processing based on a predetermined function formula.

In the present embodiment, this motion control processing can be performed to both or either of player characters in fighting games among a plurality of users. Particularly, it is more effective to perform the control processing to character B which is arranged far from the virtual camera than to perform it to character A which is closer to the virtual camera. This is because the user controlling character B can not easily recognize the positional relationship between character B and the ball, for example, the distance or angle between the ball and the racket, therefore, character B is liable to be in a disadvantageous position compared to character A. It is possible to change the extent of the amendment between characters A and B. In other words, it is also possible, within the range of the present ainvention, to amend the movement of the character which is farther away from the virtual camera preferentially to the character which is close to the virtual camera.

(Second Embodiment)

Although it is not illustrated in the 3 dimensional display screen in Fig.3, the game modes includes a night mode in which the processing of turning on the

floodlights is performed. Player character A (and player character B) and tennis ball 206 have their shadows on the surface of the court corresponding to the lights.

Fig.7 is a virtual overhead view of the display screen and the lights are irradiated from the 4 edges of the court where the 4 floodlights, 250A, 250B, 250C, and 250D respectively exist. Here, shadow 252A which is generated from the light from one floodlight 250A is constituted of polygons of a black shadow model (shadow 252B, 252C, and 252D are generated likewise).

For example, shadow 254 which is generated from 2 floodlights 250A and 250B exists independently, therefore, each is constituted of respective shadow models 252A and 252B.

Regarding the 2 shadows 252A and 252B generated for 1 object (player character A), there is common area 256 where the 2 shadows overlap and independent area 258 where the shadows do not overlap.

Because common area 256 is the shadow generated from the light of the combination of 2 floodlights, the shadow is more realistic if it is darker than the shadow of independent area 258.

At this point, as shown in Fig.9 (A) and (B), a parameter is set for the 2 shadow models 252A and 252B for changing the transparency of each of the 2 shadow models between 0 and 1 respectively, and the transparent tabular polygons 260A and 260B for achieving the gradation effect are provided for the shadow models having the black color which is displayed on the polygon. If the black shadow models 252A and 252B are pasted on the polygons, the gradation processing for changing the darkness of the shadow respectively is performed to each of the shadow models 252A and 252B at the transparency (the value α) designated by gradation tables 260A and 260B. Here, from the top to the bottom, the shadow polygon 252B, table polygon 260B, shadow polygon 252A, and table polygon 260A

overlap in this sequence.

Regarding independent area 258 where the 2 table polygons do not overlap, the darkness is respectively set by the transparency designated by both gradation tables. Regarding common area 262 where the 2 table polygons overlap, the parameters of the transparency designated by both polygon tables are applied doubly and the shadow of common area 262 is displayed more darkly than the shadow of independent area 258. Especially the part where both shadow models overlap, the shadow is displayed even darker because the texture data of the 2 shadow models overlap.

In the concrete example of a tennis court, if the court surface is lawn grass, the shadow of the independent area is dark green which is darker than the green of the lawn grass, and the shadow of the independentarea is a green which is almost black.

Furthermore, in the conventional art, the part where the shadow models overlap, for example, the joint parts of a model of a human body, has the low transparency because the value α is set for a plurality of shadow model polygons. On the other hand, in the present invention, the part where the shadows overlap is displayed in the same darkness at the same value α as the part where the shadows do not overlap, by setting that the shadow model is a polygon which does not have the value α, setting the value α to the described table polygon, and pasting the shadow model to this polygon, or if the value α for gradation processing purpose is adopted, the shadow is displayed such that the darkness changes . In a game space where a single light source is set, it is not realistic if the part where the shadow models overlap (joints of a human body model etc.) is displayed darkly. However, by adopting the structure of the present invention which is explained in this clause, it is possible to display the part where the shadow models overlap in the same darkness

as the part where the shadow models do not overlap in a same concentration, thus a realistic image can be generated. On the other hand, in a game space where a plurality of light source models exist, it is realistic that the part where the shadows overlap is displayed more darkly than the part where the shadows do not overlap. Provided however, in Fig.9 (A), the shadow parts BB, except the part AA where the shadows overlap, in area 262 where the table polygons overlap, are displayed more darkly than the shadows CC which is the rest of the shadows except the shadow AA and BB. In order to make it more realistic, it is necessary to make the part BB have the same darkness as the part CC. This will be explained in detail hereinafter.

As shown in Fig.10, there is area A256 (area AA in Fig.9) having a shadow which is extremely dark. The shadow of this area is displayed most darkly because the transparency data of 2 polygons are reflected to the 2 shadow model polygons. There is area B262 (area BB) having shadows of medium darkness. The transparency data of the 2 polygon tables is reflected to each shadow polygon, therefore, the shadow of medium darkness is generated. (area CC) is a part which has shadows of standard darkness. At this point, because the generation of the shadows of medium darkness is not realistic, the image processing which does not generate such shadows becomes necessary.

In the image processing of the tennis game of the present embodiment, as shown in Fig.10, filter table 270, which is a polygon model having a parameter (the transparency 0) which nullifies or cancels the value α of the polygon table located under polygon table 260A, is arranged on polygon table 260A. In fact, it is structured so that this filter table is arranged in advance on the polygon table which is pasted with a shadow polygon.

Because of this arrangement of filter table 270, as shown in Fig.11, area A having a shadow displayed most darkly has a color made by overlapping the 2

polygons of 2 shadow models and the shadow is displayed more darkly than the shadows of the other areas. On the other hand, in area B of medium darkness, not the transparency of polygon table 260A but the transparency of polygon table 260B is applied to the shadow model 252B, which is located on top when one views it from the top, while the transparency of the polygon table 260A is applied to the shadow polygon 252A which is below shadow model 252B. Therefore, the transparency parameter of polygon table 260B is applied to the color of each shadow model 260B and area B is displayed in the same darkness as the other area C.

The shadow models 252A and 252B, gradation tables 260A and 260B, and filter table 270 can be expressed in data form such as (R, G, B, α) respectively. R, G, and B indicates the brightness of each color, red, green, and blue, and 0 means that there is no color to be applied while 1 means that a color is reflected 100%. α means the transparency, 0 means 100% transparency, and 1 means 100% opacity.

The first shadow model 252A is (0, 0, 0, 0), and only the area of shadow is set while the model itself has no color.

The first gradation table 260A is (0, 0, 0, α_1), and α_1 can have the value of 0~1 depending on the quantity of light from floodlight 250A.

The second shadow model 252B is (0, 0, 0, 0), and only the area of shadow is set while the model itself has no color.

The second gradation table 260B is (0, 0, 0, α_2), and α_2 can take the value of 0~1 depending on the quantity of light from floodlight 250B.

Filter table 270, which is provided under the second gradation table 260B, is (0, 0, 0, 1), and the table itself has no color but is a completely obscure table.

Consequently, the degree of influence of the layers which are under filter table 270 to the upper layers is calculated by the following equation.

(0, 0, 0, 1) X (1, 1, 1, 1) + (R of bottom layer, G of bottom layer, B of bottom layer, α

of bottom layer) X (1, 1, 1, 1) + (R of bottom layer, G of bottom layer, B of bottom layer, α of bottom layer) = (R of bottom layer, G of bottom layer, B of bottom layer, 1)

Shortly, no matter what values they have, R of bottom layer, G of bottom layer, and B of bottom layer do not reflect the degree of influence because the value α in the last member is 1.

[Effect of the Invention]

As explained above, the present invention achieves the effect to provide a system in which a game using a game device can be developed smoothly by assisting the user's operation of the game device.

The present invention achieves the object to provide a game device for hitting or hitting an object such as a ball by a series of movements in a short period such as swinging a racket or a bat, wherein the series of movements are preferably matched to the behaviors of an object such as a ball by accurately assisting or helping the user's operation without impairing the user's will.

The present invention can display a highly realistic representation of the game image. The present invention can provide a game device which allows processing such that the display of shadows of objects on the game screen complies with the display of real shadows.

The present invention achieves the effect that it can perform the operation processing control which does not depend on the amount of experiences of a user of the game device, and victory or defeat is influenced only by the technology of the game itself, furthermore, it is possible to create a more realistic image by the existence of the shadow of an object moving on the screen.

[Brief Description of the Drawings]

[Fig.1] Fig.1 is a schematic block diagram of the game device according to the present invention.

[Fig.2] Fig.2 (A) is a block diagram of the operation member for performing the function of the game device and (B) is a perspective view of the operation member.

[Fig.3] Fig.3 illustrates a scene of the display screen of the display member.

[Fig.4] Fig.4 is a block diagram to perform analysis based on the timing of the movement of swinging the tennis racket.

[Fig.5] Fig.5 is a control flow chart according to the first embodiment.

[Fig.6] Fig.6 (A) is a timing chart for setting the movement mode for setting the timing of the movement of the tennis racket by inputting at the operation member, and (B) is a chart for reading the result of the timing.

[Fig.7] Fig.7 is a top view according to the second embodiment illustrating the areas of the lights illuminating the tennis court.

[Fig.8] Fig.8 is a top view illustrating the condition of shadows when only the shadow models overlap.

[Fig.9] Fig.9 (A) is a top view when the gradation tables are arranged corresponding to each of the shadow models, and (B) is a side view of (A) from the IX direction.

[Fig.10] Fig.10 illustrates the recognition of the defective shadow of Fig. 9.

[Fig.11] Fig.11 is a top view according to Claim 6 of the present invention, where the filter table is inserted in the combination of the shadow models and the gradation tables.

[Description of Reference Numerals]

51a, 51 operation member

52 sequence control member

53 display member

A, B players

204 tennis racket

206 tennis ball

208 court

200 operational buttons

212 judgment member

[Document Name] Abstract

[Abstract]

[Problem to be Solved] To perform the operation processing control which does not depend on the amount of experiences of a user of the game device, and in which victory or defeat is influenced only by the technology of the game itself, furthermore, to create a more realistic image by the existence of a shadow of an object moving on the screen.

[Solution] It is possible to solve the unfairness among the users which results from the differences in the quantity of experiences regarding the difference in timing of the series of movements (the movements of swinging a tennis racket) between a front side and a back side of a tennis court having the perspective therebetween on the display screen, by providing the time range for amending the timing before and after the predetermined time range which indicates the appropriate operation input of the operational buttons for the series of movements, and by slowing down the speed of the series of movements if the operation of the operational buttons is performed early or by quickening the speed if the operation is performed late.

[Selected Drawing] Fig.6